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OAK RIDGE NATIONAL LABORATORY

2710

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#2710

REPORT OF SUBCOMMITTEE #6

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#### ABSTRACT

The problem of non-radioactive chemical contamination of water, air, and land at ORNL has been reviewed. This report summarizes the information available on this subject.

#### INTRODUCTION

The purpose of this investigation was to identify and describe potential problem areas, recommend corrective action, and project changes which might be required in the future. These items are described under the following major headings: I. Water Pollution -- Sanitary and Chemical Wastes, II. Air Pollution, and III. Land Pollution.

## DISCUSSION

### I. WATER POLLUTION

#### A. Sanitary Wastes

Over the years since 1943 roughly, ORNL has installed a central sewage treatment facility and numerous septic tanks with drain fields. Three systems are presently in operation in addition to some isolated septic tanks: 1. the main sewage disposal plant, 2. the septic tank for the 7000 area, and 3. the activated sludge unit which is located at the HFIR area. The balance of the septic tanks (12 in number) are located throughout the Laboratory and serve in most cases only 1 to 4 people. These systems were installed in conformance with existing State regulations for septic tanks and drain fields so they really deserve no comment; their effluent does not find its way to White Oak Creek. (See Map A for locations)

#### 1. Sanitary Treatment Plant

The sanitary treatment plant has been in operation since roughly 1949 and unfortunately no accurate design data is available. The method of treatment consisted of 2-stage plane sedimentation with one hour retention in the primary, 2 hours in the secondary sedimentation tanks. The raw sewage characteristics theoretically were 150 ppm suspended solids, 175 ppm BOD. This system was designed for 2,400 population based on 60 gallons per capita per day with 2,200 of the population in the daylight hours between 6:00 a.m. and 6:00 p.m., and the remainder on

rotating shift. The sedimentation periods from the method of treatment shows 3 hours total sedimentation in 2 stages. The total throughput of this system then would be something in the neighborhood of 150,000 gallons per day.

The effluent from this plant is chlorinated and discharged directly to White Oak Creek which winds its way through approximately 1.2 miles of the controlled area and ends up at White Oak Dam (a holding pond for laboratory wastes). Efficiency studies based on COD have been performed. The plant has an overall efficiency of 40 to 50%, depending of course on the season. By the time the material is discharged from White Oak Dam, the COD is down to approximately 10 ppm. Only limited data on BOD is available but it seems to correlate with the COD. This is because there isn't anything peculiar about the operation of this plant; it is simply a sanitary treatment plant and theoretically the COD should be as good a measure of the efficiency as the BOD--and it in fact is.

2. 7000 Area Septic Tank

This septic tank which serves the 7000 area is located directly west of the 7000 area. The tank capacity of this system is 33,000 gallons; the present loading is 10,000 gallons per day and the system serves approximately 320 people.

3. Activated Sludge Unit

The sanitary treatment facility at the HFIR area is an activated sludge unit which was commercially available at the

time. This unit is a 7500 gallon-per-day system and serves some 200 people. The efficiency of this system has been suspect since date of installation.

4. Conclusions and Recommendations

Coincidental to this Committee's assignment, a sanitary engineering consultant was retained to assist in evaluating the performance of these systems. Hopefully the inadequacies of these systems will be corrected with his help. The Committee respectfully yields to his expertise in this area. Following is the present general work plan:

- a. Data necessary for design of a sand filter for the 7000 area septic tank will be obtained by ORNL and supplied to the consultant. The filter will be installed based on his recommendations and design.
- b. The consultant will determine an operating procedure for the HFIR activated sludge unit to insure proper operation. Additionally, automatic sampling equipment will be installed to secure samples for continuing efficiency studies.
- c. The present status of the sanitary treatment plant is:
  - (1) The flow has been modulated to give a continuous flow over a 24 hour period.
  - (2) The decontamination laundry wastes have been repiped to discharge directly into this system.

- (3) Continuous proportional samplers have been installed to obtain representative samples for efficiency studies.
- (4) Consideration is being given to using the emergency radiation holding pond as a waste disposal lagoon for sanitary waste. The volume of this lagoon is such that approximately 30 days retention time would be available. The consultant feels this is adequate.

B. Chemical Wastes

The Laboratory has no system specifically designed for treating non-radioactive wastes. The process waste system into which water containing radioactive materials is discharged is treated with lime, soda ash, and clay to remove strontium and cesium. This treatment also precipitates and removes all metal ions which form insoluble hydroxides. Sludge formed in this reaction is disposed of in a pit. All other chemicals, whether disposed of in this system or through the 1,000 or more laboratory sinks find their way into White Oak Creek. Further dilution is accomplished by discharge to the Clinch River--the receiving water for White Oak Creek.

With few exceptions, the Laboratory is not a user of chemicals in bulk amounts. Large quantities of nitric acid are used as an oxidant in diverse applications. Chromates, sulfuric acid, and phenols are used in large amounts for treatment of cooling towers and organic solvents are used for cleaning, in cold traps, etc. The chromates and phenols are absorbed in the wood of the cooling

towers, the solvents are lost through evaporation, and nitric acid is consumed in oxidation reactions. The balance of the chemicals are used in small lots--usually one pound or less. Annual usage of selected chemicals for 1968 and 1970 are shown in Table I. For convenience, this problem was divided into 1. general chemical wastes and 2. cooling tower wastes:

1. General Chemical Wastes

The following information has been reported in ORNL CF 71-1-49 and is included in this report for completeness.

A continuous program for evaluation of effluent waste waters from the Laboratory and the subsequent level of chemical pollutants in the Clinch River has been in operation since 1962. The location of six sampling points are shown on accompanying Map B. Station No. 1 is located on White Oak Creek, directly west of the 7000 area, on Bethel Valley Road. Station No. 2 is at White Oak Dam. Station No. 3 is on Melton Hill Lake at the bridge to the Bull Run Steam Plant. This location, upstream of the Laboratory, may be considered as the baseline for comparison with values obtained downstream. Station No. 4 is located downstream on the Clinch River at the inlet to the K-25 Water Purification Plant. Station No. 5, designated as Clinch River Mile 10 (CRM-10) is located one mile below the junction of Poplar Creek and the Clinch River. Station No. 6 is located in-plant on White Oak Creek south of the 6000 area. Weekly spot (WS) samples are taken from these locations and analyzed for



chemical oxygen demand (COD) and hexavalent chromium. The weekly spot samples are composited and an analysis is made of the quarterly composites to determine its conformity to the USPHS standards.

Annual average results of analyses made on samples from these locations are shown in Tables II through VII. The USPHS standards are included for comparison. As would be expected, Melton Hill Lake is well below the USPHS standard for potable water. White Oak Dam, holding pond for Laboratory wastes, exceeds the USPHS standard for hexavalent chromium by a factor of 2, while downstream values are well below limits for potable water and pH values are at the upper limit.

During 1968, personnel of the Laboratory purchased over 13,000 items from the Chemical Stores Department, representing 1,500 different chemical compounds. The diverse research activities at the Laboratory make it virtually impossible to estimate what percent of these chemicals were used or poured down the drain. The maximum concentration which might occur if these chemicals were discharged into the Clinch River over a given period of time, has, however, been calculated. Four discharge periods were considered: one year, one month, one week, and one day. For the purpose of this calculation, a constant discharge rate was assumed for each case and the average annual flow rate of the Clinch River of 5,000 CFS was used. The results shown in Table VIII indicate that the USPHS standard would be exceeded only in an extreme case where all

the pollutants were discarded within a day or a week--a most unlikely possibility. Chromate and phenol usage is on a 24-hour basis. The remaining pollutants are discharged primarily on the day shift. Table IX shows calculated concentrations in the Clinch River assuming discharge on the basis of an 8-hour day, 40-hour week. Chromium and phenols are the only contaminants which exceed the USPHS standard.

A comparison of calculated values and actual analytical results from White Oak Creek embayment is shown in Table X. White Oak Creek embayment serves as a holding pond for both radioactive decay and biological oxidation of organic materials. The average discharge rate is 14 CFS to the Clinch River. The dilution factor from White Oak Dam to the Clinch River is 350x. Calculated values for  $\text{Cr}^{+6}$  and phenols are based on a 24-hour day while  $\text{Cl}^-$  and  $\text{SO}_4^{=}$  calculations were based on an 8-hour day. The analytical results for chlorides, chromium, and sulfates compare favorably with the calculated values. The variation between the phenol values probably reflects adsorption of the fungicide in the wood of the cooling towers and subsequent biological degradation in White Oak Creek and White Oak Lake.

## 2. Cooling Tower Wastes

With the preceding information in mind it would appear (at least on the surface) that the only real problem the Laboratory faces is the area of chemical pollution results from the chromate usage and pH control at White Oak Dam.

Table XI shows a comparison of the results of  $\text{Cr}^{+6}$  analyses for the various sampling points during 1968 and 1969. While the results at White Oak Dam are above the USPHS standard, it will be noted that downstream samples are well below acceptable limits.

To characterize further the chromate levels in-plant, an audit was made of White Oak Creek. There are four cooling towers within the Plant, whose treatment may elevate the hexavalent chromium content of the effluent waters.

Locations of the sampling points are shown on Map B. These results shown in Table XII indicate that while the concentration of  $\text{Cr}^{+6}$  is elevated adjacent to the cooling towers, the level is considerably lower at the White Oak Dam. The average flow rate of White Oak Creek is 12-14 CFS; and subsequent dilution by the Clinch River as shown in the previous table results in a concentration well below the USPHS standard for potable water.

Any industrial complex large enough to require a cooling tower may be inadvertently polluting the adjacent streams with pentachlorophenol. This fungicide is used to treat the cooling towers for algae and slime control. While it is available commercially under a variety of trade names, the primary ingredient is sodium pentachlorophenate. Procedure for treatment of the cooling towers at the Oak Ridge National Laboratory requires the simple addition of a calculated amount of the fungicide to obtain a concentration of 200 ppm. Depending on the size of the tower to be treated, the blowdown is stopped for up to

8 hours and the PCP is circulated through the entire system. At the time of resumption of normal operation, the blowdown water may contain up to 100 mg/l of PCP. The frequency and volume of blowdown varies with the average daily temperature, winter being the period of minimal discharge to White Oak Creek.

Annual usage figures for the various cooling towers are given in Table XIII. Also shown are figures for makeup, blowdown, etc.

### 3. Conclusions and Recommendations

- a. Pollution which results from the general chemical wastes is minimal. Unless much more restrictive limits are instituted no particular problem is anticipated.
- b. Pollution which results from the cooling tower wastes discharged at various points along White Oak Creek and Melton Branch do represent a significant problem. Several alternatives are available and the economics of this problem will have to be reviewed carefully to arrive at the optimum solution.
  - (1) The miscellaneous systems (13 in number) might be switched to air to air to eliminate chromate usage. This is no panacea because some cannot be converted.
  - (2) The amounts of chromates used at HFIR, ORR, BSR, etc., could be greatly reduced if it could be shown that the corrosion rates were not adversely affected by a

reduced chromate concentration. HFIR is already studying this possibility.

- (3) Chromate removal is theoretically possible with commercially available equipment--at least according to the manufacturer. It might be more enlightening to talk with an installation which has a system in operation to get a better idea of the operating costs and problems of maintaining efficient removal of chromates. Burial of the chromate sludge is acceptable for the present and there would appear to be no economic advantage to recovering the chromate. Two systems would be required--one for the HFIR area and one for the Laboratory area. HFIR is also investigating this possibility to eliminate the chromate problem in Melton Valley. The application of a chromate removal system to Bethel Valley would require pumps and piping to collect cooling water blowdown at a central point for removal of the chromates.

C. D. Cagle has been assigned the problem of assembling cost information and other associated data necessary to prepare a proposal to be submitted as a line item as soon as possible.

- (4) To define whether a problem exists from pH, the Industrial Hygiene Department has requested funds for a continuous pH measurement at White Oak Dam. Other stations along White Oak Creek will be installed as indicated.

## II. AIR POLLUTION

The absence of black smoke from stacks and smog in general clearly indicates that air pollution in the general sense does not exist at the Laboratory.

The Industrial Hygiene Department has for several years been securing outside air samples at selected sites to be certain beryllium is not being discharged to the atmosphere from the many activities involving beryllium. At the same time, a complete cation analysis has been made on these environmental samples. Cations of special interest include cadmium, nickel and lead. Results of these analyses indicate that significant quantities of these materials are not discharged to the atmosphere.

The problem of  $\text{SO}_2$  in the atmosphere has been reviewed on several occasions as it is affected by the steam plant operation. Fortunately the steam plant is fired by natural gas. A typical analysis of this gas as it is received contains 0.80%  $\text{CO}_2$ , 0.28% nitrogen, 93.4%  $\text{CH}_4$ , 3.22%  $\text{C}_2\text{H}_6$ , 0.42%  $\text{C}_4\text{H}_{10}$ , 0.11%  $\text{C}_5\text{H}_{12}$ , 0.28%  $\text{C}_6\text{H}_{14}$ , and 8.6 grains of total sulfur/1000 cu. ft. of fuel. This amount of sulfur will burn to form  $3.69 \times 10^{-4}$  pounds of  $\text{SO}_2$  per 1000 cu. ft. of fuel and corresponds to the number of pounds per 1,000,000 BTU. Based on calculated flows in the stack,  $\text{SO}_2$  concentration is 0.23 ppm. No difficulties are anticipated from this amount of  $\text{SO}_2$ .

The present environmental air sampling program of the Industrial Hygiene Department includes the following:

1. Suspended particulates
2.  $\text{SO}_3$
3. Fallout
4. Cation analysis of the suspended particulates

That Department is in the process of preparing a comprehensive report of this data. The major conclusion of this report will be that air in the vicinity of ORNL compares with air in rural Tennessee. A typical set of analytical data is given in Table XIV. Some values for Nashville are given for comparison purposes. It is likely that the Industrial Hygiene Department will have to expand their environmental monitoring program to insure compliance as regulations are promulgated. For example: Tennessee Air Pollution Control Regulations effective August 9, 1969 (See Table XV) are based entirely on a land area classification and presently apply to only three contaminants--dustfall, suspended particulates and reactive sulfur ( $\text{SO}_3$ ).

#### Conclusions and Recommendations

The present environmental sampling program is adequate to demonstrate the Laboratory is not excessively polluting the atmosphere with chemicals. As new regulations are established this program will have to expand to verify compliance.

### III. LAND POLLUTION

Dry refuse and cafeteria garbage is deposited in Dumpster pans or in conventional garbage pans which are spotted at various locations within the Laboratory, or is piled at the job site as the occasion demands. This is collected by truck and crew, transported to the transfer station, deposited in a compactor type trailer, hauled to the central land fill which is in Bear Creek Valley and which is operated by Y-12 personnel for the three UCC-ND Oak Ridge plants.

Metal turnings from machine shops and rubble remaining from construction are collected and trucked to a preselected excavation usually a ravine, and spoiled until the required contour is obtained. The area is then dressed and seeded.

Classified papers are passed through a pulverizing machine at either X-10 or Y-12, convenience is the determining factor. Output from the X-10 unit goes into Dumpster pans. Y-12 personnel handle the output of the Y-12 unit.

Waste cardboard is given away under contractual agreement for the expense of hauling away. Retired property items, waste oils, scrap material, used IBM cards, and used mercury batteries are sold through UCC-ND Property Sales at ORGDP.

Quantities of solvents, acids, pyrophorics, beryllium, sludge from waste water treatment plant and sewage plant are disposed of in the ground in the X-10 area.

Weed killers, emulsified asphalt, fertilizers, pesticides and exhaust from powered--gasoline engine as well as diesel engine--equipment are released to the environment through usage.

#### Conclusions and Recommendations

The present burial practices are a result of recommendations of the ORO Environmental Pollution Task Force established in 1966 and composed of representatives of the AEC, ORNL, Y-12, ORGDP, Paducah, NLO-Cincinnati, and GAT-Portsmouth. The first report of this task group was issued in October, 1967. This is a continuing task group which considers any and all types of pollution. This committee feels no recommendations are in order at this time.



TABLE I

ORNL USAGE OF VARIOUS CHEMICALS

1968 vs. 1970

<u>Chemical</u>	<u>Total Lbs. Used</u>	
	<u>1968</u>	<u>1970</u>
Phenols	107	4,570
Arsenic	2	1.8
Barium	23	22.5
Cadmium	2	0.4
Chloride	26,240	72,150
Chromium <sup>+6</sup>	13,764	8,355
Copper	58	91
Fluorides	245 +	295
Iron	150	25
Manganese	11	6.1
Nitrates	113,255	23,611
Sulfates	465,670	143,016
Zinc	24	25

TABLE II

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT MELTON HILL

Contaminant	USPHS Standard	1968	1969*
Cl <sup>-</sup>	250	1.355	3.25
CN <sup>-</sup>	0.01		
F	1.7	0.00	0.47
NO <sub>3</sub>	45		
Phenols	0.001	.0002	
SO <sub>4</sub> <sup>=</sup>	250	14.7	14.0
TDS	500	85.5	93.5
SS		3.6	4.8
pH	6-9	9.2	7.9
COD		3.4	4.3
Ag	0.05	<.005	<.002
As	0.01	<.1	<.1
Ba	1.0	.012	.025
Be	1.0	<.001	<.001
Cd	0.01	<.03	<.03
Cr <sup>+6</sup>	0.05	0.05	.01
Cu	1.0	.009	.007
Fe	0.3	.03	.03
Mn	0.05	.011	.01
Pb	0.05	<.010	.01
Zn	5	<.100	<.1
Tot. Alk.		54.7	63.0

\*First 6 months

NOTE: No data available for years prior to 1968 because the sampling point was not established until 1968.

TABLE III

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT WHITE OAK DAM

Contaminant	USPHS Standard	1962	1963	1964	1965	1966	1967	1968	1969
Cl <sup>-</sup>	250	8.3	9.1	9.7	114.0	44.7	87.7	3.6	5.8
CN <sup>-</sup>	0.01		.02	.02					
F	1.7		.48	.38	.10	.13	.15	.05	.50
NO <sub>3</sub>	45	3.8	5.7	13.0					
Phenols	0.001		.0043	.0010				.0003	
SO <sub>4</sub> <sup>=</sup>	250	50.5	25.7	35.0				38.0	31.3
TDS	500	235.5	187.4	190.6	142.3	263.6	182.0	151.1	153.7
SS					77.8			.57	.93
pH	6-9	8.0	7.9	7.7	6.1	5.7	5.8	9.1	8.5
COD								8.0	11.5
Ag	0.05			<.005	<.01	<.01	<.01	.003	0.002
As	0.01		.00	<.02	<.01	<.04	<.10	<0.1	<0.1
Ba	1.0					0.02	.085		.04
Be	1.0	.182	.493	<.001	<.001	<.001	<.001	<.001	<.001
Cd	0.01		.10	<.02	<.01	<.02	<.03	<.03	<.03
Cr <sup>+6</sup>	0.05	.08	.05	.01	.03	.03		0.13	0.13
Cu	1.0	.08	.09	0.17	.025	.238	.02	.009	.007
Fe	0.3	.162	.293	.135	.030	.11	.22	.007	0.040
Mn	0.05		.154	.023	.015	.030	.011	.007	0.01
Pb	0.05		.110	.01	<.010	.032	<.02	<.01	<.02
Zn	5			.021	<.01	<.05	<0.2	<0.1	.10
Tot. Alk.		106.7	108.9	101.3	10.0	14.7	16.0	49.3	66.0

TABLE IV

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT K-25 PUMPING STATION (CRM-14.5)

Contaminant	USPHS Standard	1964	1965	1966	1967	1968	1969
Cl <sup>-</sup>	250	38.1		20.0	20.7	2.3	2.8
CN <sup>-</sup>	0.01						
F	1.7	0.00		0.40	0.10	0.00	0.54
NO <sub>3</sub>	45						
Phenols	0.001					.0001	
SO <sub>4</sub> <sup>=</sup>	250	13.2			28.0	15.5	12.7
TDS	500	117.1	56.5	203.0	153.0	95.0	103.3
SS		14.8				3.0	3.5
pH	6-9	7.8	8.2	7.7	7.3	8.7	8.5
COD						4.0	3.0
Ag	0.05	<.01	<.01	<.01	.002	<.005	<.002
As	0.01	<0.01	<0.01	<0.01	<0.10	<0.10	<0.10
Ba	1.0			.01	.05		.07
Be	1.0	<.001	<.001	<.001	<.001	<.001	<.001
Cd	0.01	<0.01	<0.01	0.02	<.01	<0.03	<0.03
Cr <sup>+6</sup>	0.05	.01	.01		.01	0.02	0.01
Cu	1.0	<.01	.014	<.01	.04	.008	.020
Fe	0.3	.025	.016	<.01	.017	.009	.04
Mn	0.05	<.010	<.01	<.01	.04	<.005	.010
Pb	0.05	<.010	<.01	<.01	.015	<.01	<.01
Zn	5	<.03	<.02	.01	.015	<.100	<.100
Tot. Alk.		95.0		105.0	39.0	70.0	73.0

NOTE: No data available for years prior to 1964 because the sampling point was not established until 1964.

TABLE V

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN AT  
CRM-10

Contaminant	USPHS Standard	1968	1969
Cl <sup>-</sup>	250	1.4	3.2
CN <sup>-</sup>	0.01		
F	1.7	0.0	0.32
NO <sub>3</sub>	45		
Phenols	0.001	.0001	
SO <sub>4</sub> <sup>=</sup>	250	16.5	13.2
TDS	500	82.3	118.3
SS		1.5	1.8
pH	6-9	9.3	8.6
COD		4.6	3.4
Ag	0.05	<.005	<.002
As	0.01	<.1	<.1
Ba	1.0	0.1	.03
Be	1.0	<.001	<.001
Cd	0.01	<.03	<.03
Cr <sup>+6</sup>	0.05	.01	
Cu	1.0	.007	.007
Fe	0.3	.02	.03
Mn	0.05	.004	.01
Pb	0.05	.01	<.02
Zn	5	<0.10	<0.10
Tot. Alk		67.7	81.0

NOTE: No data available for years prior to 1968 because the sampling point was not established until 1968.

TABLE VI

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT WHITE OAK CREEK AT 6000 AREA

Contaminant	USPHS Standard	1963	1968	1969
Cl <sup>-</sup>	250	3.0		
CN <sup>-</sup>	0.01			
F	1.7	0.43		
NO <sub>3</sub>	45	1		
Phenols	0.001	<0.001		
SO <sub>4</sub> <sup>=</sup>	250	15.0		
TDS	500	107		
pH	6-9	8.31		
COD			6.3	3.1
Ag	0.05			
As	0.01	.004		
Ba	1.0			
Be	1.0	0.43		
Cd	0.01	<0.01		
Cr <sup>+6</sup>	0.05	<0.01		
Cu	1.0	<0.1		
Fe	0.3	<0.1		
Mn	0.05	<0.1		
Pb	0.05	<0.1		
Se	0.01			
Zn	5	<0.1		
Tot. Alk.		97		

TABLE VII

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT WHITE OAK CREEK AT 7000 AREA

Contaminant	USPHS Standard	1963	1968	1969
Cl <sup>-</sup>	250	<1		
CN <sup>-</sup>	0.01			
F	1.7	<0.05		
NO <sub>3</sub>	45	<1		
Phenols	0.001	<0.001		
SO <sub>4</sub> <sup>=</sup>	250	3.3		
TDS	500	67		
pH	6-9	7.85		
COD			6.3	7.6
Ag	0.05			
As	0.01			
Ba	1.0			
Be	1.0	0.59		
Cd	0.01	<0.1		
Cr <sup>+6</sup>	0.05	<0.1		
Cu	1.0	<0.1		
Fe	0.3	<0.1		
Mn	0.05	<0.1		
Pb	0.05	<0.1		
Se	0.01			
Zn	5	<0.1		
Tot. Alk.		102		

TABLE VIII

CALCULATED CONCENTRATIONS OF VARIOUS SUBSTANCES  
IN CLINCH RIVER AT AVERAGE FLOW OF 5000 CFS

SUBSTANCE	Usage (lbs) 1968	Calculated Concentration (mg/l)				USPHS Standard (mg/l)
		One Year	30-Day Month	7-Day Week	24 Hours	
Arsenic	2	$2.0 \times 10^{-7}$	$2.4 \times 10^{-6}$	$1.0 \times 10^{-5}$	$7.4 \times 10^{-5}$	0.01
Barium	23	$2.3 \times 10^{-6}$	$2.9 \times 10^{-5}$	$1.2 \times 10^{-4}$	$8.5 \times 10^{-4}$	1.0
Cadmium	2	$2.0 \times 10^{-7}$	$2.4 \times 10^{-6}$	$1.0 \times 10^{-5}$	$7.4 \times 10^{-5}$	0.01
Chromium	13219	0.001	0.017	0.073	0.51	0.05
Copper	58	$5.8 \times 10^{-6}$	$7.1 \times 10^{-5}$	$3.0 \times 10^{-4}$	0.002	1.0
Iron	150	$1.5 \times 10^{-5}$	$1.8 \times 10^{-4}$	$8.0 \times 10^{-4}$	0.006	0.3
Lead	16	$1.3 \times 10^{-6}$	$2.0 \times 10^{-5}$	$8.4 \times 10^{-5}$	$5.9 \times 10^{-4}$	0.05
Manganese	11	$1.1 \times 10^{-6}$	$1.3 \times 10^{-5}$	$5.7 \times 10^{-5}$	$4.0 \times 10^{-4}$	0.02
Zinc	24	$2.4 \times 10^{-6}$	$2.9 \times 10^{-5}$	$1.2 \times 10^{-4}$	$8.8 \times 10^{-4}$	5.0
Chlorides	26240	.002	.032	0.13	0.97	250
Cyanide	51	$4.9 \times 10^{-6}$	$6.3 \times 10^{-5}$	$2.7 \times 10^{-4}$	.002	0.01
Fluorides	245	$2.0 \times 10^{-5}$	$3.0 \times 10^{-4}$	.001	0.01	1.3
Nitrates	113,255	0.011	0.140	0.60	4.2	45
Sulfates	465,670	0.040	.57	2.4	17.3	250
Phenols (as PCP)	28023	0.004	0.043	0.186	1.305	0.001



TABLE IX

CALCULATED CONCENTRATIONS OF VARIOUS SUBSTANCES  
IN CLINCH RIVER AT AVERAGE FLOW OF 5000 CFS

SUBSTANCE	Usage (lbs) 1968	Calculated Concentration (mg/l)				USPHS Standard (mg/l)
		264-Day Year	22-Day Month	40-Hr. Week	8-Hr. Day	
Arsenic	2	$8.3 \times 10^{-7}$	$1.0 \times 10^{-5}$	$4.4 \times 10^{-5}$	$2.22 \times 10^{-4}$	0.01
Barium	23	$9.3 \times 10^{-6}$	$1.1 \times 10^{-4}$	$4.9 \times 10^{-4}$	0.003	1.0
Cadmium	2	$8.3 \times 10^{-7}$	$1.0 \times 10^{-5}$	$4.4 \times 10^{-5}$	$2.22 \times 10^{-4}$	0.01
Chromium	13219	0.006	0.067	0.295	1.474	0.05
Copper	58	$2.3 \times 10^{-5}$	$2.7 \times 10^{-4}$	.001	0.006	1.0
Iron	150	$6.8 \times 10^{-5}$	$8.1 \times 10^{-4}$	.004	0.018	0.3
Lead	16	$6.7 \times 10^{-6}$	$8.0 \times 10^{-5}$	$4.0 \times 10^{-4}$	0.002	0.05
Manganese	11	$4.5 \times 10^{-6}$	$5.4 \times 10^{-5}$	$2.0 \times 10^{-4}$	0.001	0.02
Zinc	24	$9.3 \times 10^{-6}$	$1.1 \times 10^{-4}$	$4.9 \times 10^{-4}$	0.003	5.0
Chlorides	26240	0.011	0.132	0.582	2.91	250
Cyanide	51	$2.3 \times 10^{-5}$	$2.7 \times 10^{-4}$	0.001	0.006	0.01
Fluorides	245	$1.1 \times 10^{-4}$	0.001	0.006	0.030	1.3
Nitrates	113,255	0.048	0.57	2.52	12.60	45
Sulfates	465,670	0.197	2.36	10.4	51.9	250
Phenols	28023	0.012	0.142	0.624	3.120	0.001

TABLE X

COMPARISON OF CALCULATED VALUES OF CHEMICAL CONCENTRATION  
WITH ANALYTICAL RESULTS

	Annual Usage (lbs)	W.O.D. Calculated (mg/l)	W.O.D. Analysis (mg/l)	USPHS Standard
Cr <sup>+6</sup> *	13,219	.48	.13	0.05
Cl <sup>-</sup>	26,240	4.02	5.83	250
SO <sub>4</sub>	465,670	6.21	31.3	250
Phenol*	28,023	1.02	.0003	.001

\*7 days -- 24 hr. day

TABLE XI

Cr<sup>+6</sup> CONCENTRATION IN EFFLUENT WATERS OF THE  
OAK RIDGE NATIONAL LABORATORY\*

	Station No. 3 Melton Hill		Station No. 2 White Oak Dam		Station No. 4 CRM-14.5		Station No. 5 CRM-10	
YEAR	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>
1968	0.100	.019	0.350	0.130	0.090	.020	.080	0.017
1969	0.100	.017	.420	.131	.090	.021	.080	.021
Stream Flow, CFS	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>
	22000	5000	298	14	22000	5000	22000	5000

\* Reported as mg/l

TABLE XII

AUDIT OF  $\text{Cr}^{+6}$  IN SPECIAL WATER SAMPLES

NUMBER	LOCATION	12/9/69	12/12/69*	12/16/69	12/23/69	Avg.
SS-1	7000 Area	.08	.020	.025	.025	.04
SS-2	6000 Area	1.17	.55	.75	.34	.70
SS-3	East Portal	.92	.40	.57	.28	.54
SS-4	4500 East	.90	.37	.57	.28	.53
SS-5	4500 Cooling Tower	.68	.28	.40	.38	.44
SS-6	4500 Central	1.43	.29	.50	.38	
SS-7	4500 West	.42	.011	1.50	.10	
SS-8	4508	.61	.22	1.22	.25	
SS-9	3500	.56	.38	.94	.45	
SS-10	2500	.53	.20	.87	.32	
SS-11	Last Chance	.56	.35	.72	.34	
WS-	Melton Hill	.03		.03		
WS-	White Oak Dam	.50		.42		
WS-	K-25	.04		.035		
WS-	CRM-10	.04		.045		

\*0.25 inches rainfall

TABLE XIII

## COOLING TOWER DATA

Area Served	Annual Usage of Chemicals		Biocide**	Makeup	Blowdown	Drift	Evaporation
	Oracol*	H <sub>2</sub> SO <sub>4</sub>					
	lbs.	gals.	gals.	gpm	gpm	gpm	gpm
HFIR (7902)	26,000	19,000	960	700	115	50	535
ORR (3103)	8,245	5,410	394	241	42	27	172
ORR (3086)	737	166	56	9.2	2.5	1.7	5.0
ORR (3089)	361	27	56	11.6	4.0	2.7	4.9
BSR (3117)	756	250	279	18.3	4.9	2.7	10.7
4500 Area	5,200	3,800	800	200	27	20	153
ORIC (6001)	2,600	1,900	400	100	13	10	77
Miscellaneous-13	700	none	225	40	12	8	20
Total	44,599	30,553	3,170	1,320	220	123	978

\*Weight % CrO<sub>3</sub> in Oracol is 44.2%

\*\*Weight % Pentachlorophenols is approx. 20% and approx. 8.5 lb/gal.  
Total weight is approximately 28,000 lbs.

TABLE XIV

STATION NO. 1 (SOUTH OF BLDG. 3500)  
FIRST QUARTER 1970

	Units	Tenn. Air Poll. Limits	Results	Urban Nashville
Suspended Particulates	$\mu\text{g}/\text{m}^3$	100-200	72	141
Dustfall	$\text{g}/\text{m}^2/30\text{day}$	9-18	3.32	
$\text{SO}_3$	$\text{mg}/100\text{cm}^2/\text{day}$	0.8	.268	
Al	$\mu\text{g}/\text{m}^3$		.780	
B			.010	
Ba			.009	
Ca			.280	
Cd			.008	.016
Cr			.022	.029
Cu			.038	.080
Fe			.440	2.100
K			.194	
Li			.005	
Mg			.054	
Mn			.074	.060
Na			.518	
Ni			.016	.030
Pb			.130	.040
Rb			.004	
Si			1.000	
Sn			.005	.110
Th			.011	.060
Zn			.050	.250

The following cations were analyzed for and not detected:

Ag Be Co Hg P Pt Sr V Zr

TABLE XV

TENNESSEE AIR POLLUTION CONTROL REGULATIONS  
(Effective August 9, 1969)

<u>ANALYSIS</u>	<u>LAND AREA CLASSIFICATION</u>	<u>AMBIENT AIR STANDARDS</u>
Dustfall	A	9* - 18** gms/M <sup>2</sup> /30 day period
	B	5* - 10** gms/M <sup>2</sup> /30 day period
	C	3* - 6** gms/M <sup>2</sup> /30 day period
	D	2* - 4** gms/M <sup>2</sup> /30 day period
Suspended Particulates	A	100* - 200** µgm/M <sup>3</sup> /30 day period
	B	75* - 150** µgm/M <sup>3</sup> /30 day period
	C	60* - 120** µgm/M <sup>3</sup> /30 day period
	D	40* - 80** µgm/M <sup>3</sup> /30 day period
Reactive Sulfur (SO <sub>3</sub> )	A	0.8 mgs/100 cm <sup>2</sup> /30 day period
	B	0.6 mgs/100 cm <sup>2</sup> /30 day period
	C	0.4 mgs/100 cm <sup>2</sup> /30 day period
	D	0.4 mgs/100 cm <sup>2</sup> /30 day period

\*Not to be exceeded more than 50% of time during any 12 month period.

\*\*Not to be exceeded during any 30 day period.

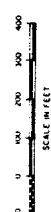
LAND AREA CLASSIFICATION

Area classification "A" shall include land areas devoted predominantly to industrial operations having considerable potential for air pollution, including fuel-burning installations, salvage or incineration activities.

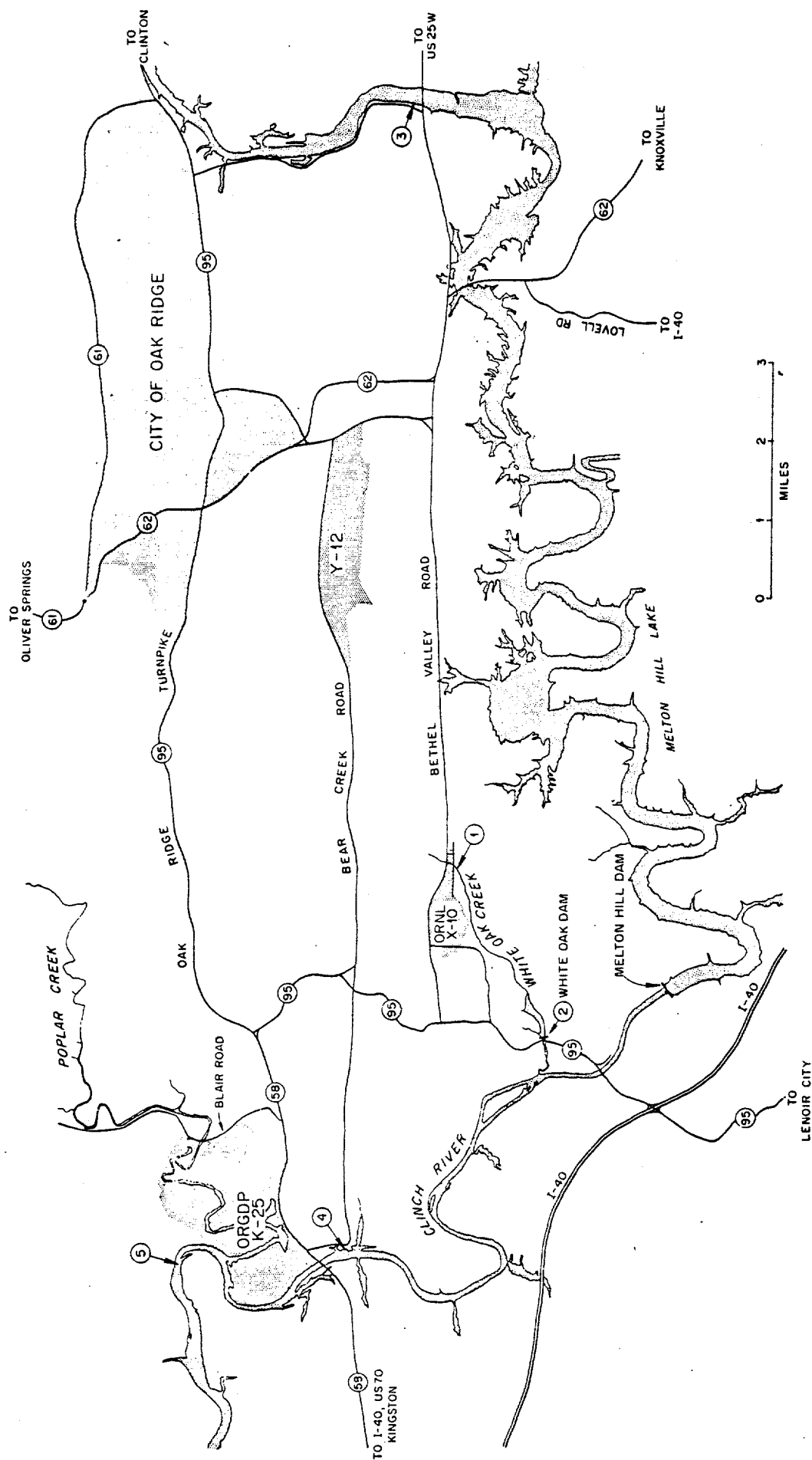
Area classification "B" shall include land areas devoted predominantly to commercial establishments and industrial operations having moderate potential for air pollution, but may also include some residential use such as high rise apartments and other multiple occupancy units.

Area classification "C" shall include land areas devoted predominantly to residential or agricultural use, but may include other land uses having slight potential for air pollution.

Area classification "D" shall include land areas devoted predominantly to recreation, forestry, wildlife, and other nature preserves. It is intended that such classification apply only to relatively large areas of not less than one square mile having minimal potential for air pollution.







Location of Sampling Stations

MAP B

TABLE I

## EFFICIENCY STUDIES OF SANITARY TREATMENT PLANT

## I. BASED ON C.O.D.

<u>Avg. C.O.D. Influent</u>	<u>Avg. C.O.D. Effluent</u>	<u>% C.O.D. Reduction</u>	<u>Avg. C.O.D. W.O.D.</u>	<u>% Overall Reduction</u>
140	71	49%	6	96%

## II. BASED ON B.O.D.

<u>Avg. B.O.D. Influent</u>	<u>Avg. B.O.D. Effluent</u>	<u>% B.O.D. Reduction</u>	<u>Avg. B.O.D. W.O.D.</u>	<u>% Overall Reduction</u>
74	37	50%	2.5	97%

This document has been approved for release  
to the public by:

*David R. Hamm* 4/29/96  
Technical Information Officer Date  
ORNL Site

*August 1971*

TABLE II

IN-PLANT Cr<sup>+6</sup> CONCENTRATIONS (ppm)\*  
(Average Concentration, ppm)

<u>Station 1</u>	<u>Station 2</u>	<u>Station 3</u>	<u>Station 4</u>
.17	.34	.26	.77

\*First Quarter Results, 1971 (11 week average)

TABLE III

Cr<sup>+6</sup> CONCENTRATION AT SELECTED SITES  
(2 Year Average, ppm)

Melton Hill		W.O.D.		CRM 14.5		CRM-10	
<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>
0.100	.018	0.385	0.131	0.090	0.020	0.080	0.019

STREAM FLOW  
(CFS)

Melton Hill		W.O.D.		CRM 14.5		CRM-10	
<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>
22000	5000	298	14	22000	5000	22000	5000

TABLE IV

PHENATE CONCENTRATION AT SELECTED SITES  
(ppm)

	<u>Melton Hill</u>	<u>W.O.D.</u>	<u>CRM 14.5</u>	<u>CRM-10</u>
1968	.0002	.0003	.0001	.0001
1970 3rd & 4th quarter	.0004	.0005	.0003	.0003

STREAM FLOW  
(CFS)

<u>Melton Hill</u>		<u>W.O.D.</u>		<u>CRM 14.5</u>		<u>CRM-10</u>	
<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>	<u>Max</u>	<u>Avg</u>
22000	5000	298	14	22000	5000	22000	5000

TABLE V

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT WHITE OAK CREEK AT 7000 AREA

Contaminant	USPHS Standard	1963	1968	1969
Cl <sup>-</sup>	250	<1		
CN <sup>-</sup>	0.01			
F	1.7	<0.05		
NO <sub>3</sub>	45	<1		
Phenols	0.001	<0.001		
SO <sub>4</sub> <sup>=</sup>	250	3.3		
TDS	500	67		
pH	6-9	7.85		
COD			6.3	7.6
Ag	0.05			
As	0.01			
Ba	1.0			
Be	1.0	0.59		
Cd	0.01	<0.1		
Cr <sup>+6</sup>	0.05	<0.1		
Cu	1.0	<0.1		
Fe	0.3	<0.1		
Mn	0.05	<0.1		
Pb	0.05	<0.1		
Se	0.01			
Zn	5	<0.1		
Tot. Alk.		102		

TABLE VI

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT WHITE OAK DAM

Contaminant	USPHS Standard	1962	1963	1964	1965	1966	1967	1968	1969
Cl <sup>-</sup>	250	8.3	9.1	9.7	114.0	44.7	87.7	3.6	5.8
CN <sup>-</sup>	0.01		.02	.02					
F	1.7		.48	.38	.10	.13	.15	.05	.50
NO <sub>3</sub>	45	3.8	5.7	13.0					
Phenols	0.001		.0043	.0010				.0003	
SO <sub>4</sub> <sup>=</sup>	250	50.5	25.7	35.0				38.0	31.3
TDS	500	235.5	187.4	190.6	142.3	263.6	182.0	151.1	153.7
SS					77.8			.57	.93
pH	6-9	8.0	7.9	7.7	6.1	5.7	5.8	9.1	8.5
COD								8.0	11.5
Ag	0.05			<.005	<.01	<.01	<.01	.003	0.002
As	0.01		.00	<.02	<.01	<.04	<.10	<0.1	<0.1
Ba	1.0					0.02	.085		.04
Be	1.0	.182	.493	<.001	<.001	<.001	<.001	<.001	<.001
Cd	0.01		.10	<.02	<.01	<.02	<.03	<.03	<.03
Cr <sup>+6</sup>	0.05	.08	.05	.01	.03	.03		0.13	0.13
Cu	1.0	.08	.09	0.17	.025	.238	.02	.009	.007
Fe	0.3	.162	.293	.135	.030	.11	.22	.007	0.040
Mn	0.05		.154	.023	.015	.030	.011	.007	0.01
Pb	0.05		.110	.01	<.010	.032	<.02	<.01	<.02
Zn	5			.021	<.01	<.05	<0.2	<0.1	.10
Tot. Alk.		106.7	108.9	101.3	10.0	14.7	16.0	49.3	66.0

TABLE VII

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN  
AT MELTON HILL

Contaminant	USPHS Standard	1968	1969*
Cl <sup>-</sup>	250	1.355	3.25
CN <sup>-</sup>	0.01		
F	1.7	0.00	0.47
NO <sub>3</sub>	45		
Phenols	0.001	.0002	
SO <sub>4</sub> <sup>=</sup>	250	14.7	14.0
TDS	500	85.5	93.5
SS		3.6	4.8
pH	6-9	9.2	7.9
COD		3.4	4.3
Ag	0.05	<.005	<.002
As	0.01	<.1	<.1
Ba	1.0	.012	.025
Be	1.0	<.001	<.001
Cd	0.01	<.03	<.03
Cr <sup>+6</sup>	0.05	0.05	.01
Cu	1.0	.009	.007
Fe	0.3	.03	.03
Mn	0.05	.011	.01
Pb	0.05	<.010	.01
Zn	5	<.100	<.1
Tot. Alk.		54.7	63.0

\*First 6 months

NOTE: No data available for years prior to 1968 because the sampling point was not established until 1968.



TABLE VIII

## AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN

AT K-25 PUMPING STATION (CRM-14.5)

Contaminant	USPHS Standard	1964	1965	1966	1967	1968	1969
Cl <sup>-</sup>	250	38.1		20.0	20.7	2.3	2.8
CN <sup>-</sup>	0.01						
F	1.7	0.00		0.40	0.10	0.00	0.54
NO <sub>3</sub>	45						
Phenols	0.001					.0001	
SO <sub>4</sub> <sup>=</sup>	250	13.2			28.0	15.5	12.7
TDS	500	117.1	56.5	203.0	153.0	95.0	103.3
SS		14.8				3.0	3.5
pH	6-9	7.8	8.2	7.7	7.3	8.7	8.5
COD						4.0	3.0
Ag	0.05	<.01	<.01	<.01	.002	<.005	<.002
As	0.01	<0.01	<0.01	<0.01	<0.10	<0.10	<0.10
Ba	1.0			.01	.05		.07
Be	1.0	<.001	<.001	<.001	<.001	<.001	<.001
Cd	0.01	<0.01	<0.01	0.02	<.01	<0.03	<0.03
Cr <sup>+6</sup>	0.05	.01	.01		.01	0.02	0.01
Cu	1.0	<.01	.014	<.01	.04	.008	.020
Fe	0.3	.025	.016	<.01	.017	.009	.04
Mn	0.05	<.010	<.01	<.01	.04	<.005	.010
Pb	0.05	<.010	<.01	<.01	.015	<.01	<.01
Zn	5	<.03	<.02	.01	.015	<.100	<.100
Tot. Alk.		95.0		105.0	39.0	70.0	73.0

NOTE: No data available for years prior to 1964 because the sampling point was not established until 1964.

TABLE IX

AVERAGE CONCENTRATION OF CHEMICALS IN WATER SAMPLES TAKEN AT  
CRM-10

Contaminant	USPHS Standard	1968	1969
Cl <sup>-</sup>	250	1.4	3.2
CN <sup>-</sup>	0.01		
F	1.7	0.0	0.32
NO <sub>3</sub>	45		
Phenols	0.001	.0001	
SO <sub>4</sub> <sup>=</sup>	250	16.5	13.2
TDS	500	82.3	118.3
SS		1.5	1.8
pH	6-9	9.3	8.6
COD		4.6	3.4
Ag	0.05	<.005	<.002
As	0.01	<.1	<.1
Ba	1.0	0.1	.03
Be	1.0	<.001	<.001
Cd	0.01	<.03	<.03
Cr <sup>+6</sup>	0.05	.01	
Cu	1.0	.007	.007
Fe	0.3	.02	.03
Mn	0.05	.004	.01
Pb	0.05	.01	<.02
Zn	5	<0.10	<0.10
Tot. Alk		67.7	81.0

NOTE: No data available for years prior to 1968 because the sampling point was not established until 1968.

TABLE X

CALCULATED CONCENTRATIONS OF VARIOUS SUBSTANCES  
IN CLINCH RIVER AT AVERAGE FLOW OF 5000 CFS

SUBSTANCE	Usage (lbs) 1968	Calculated Concentration (mg/l)				USPHS Standard (mg/l)
		One Year	30-Day Month	7-Day Week	24 Hours	
Arsenic	2	$2.0 \times 10^{-7}$	$2.4 \times 10^{-6}$	$1.0 \times 10^{-5}$	$7.4 \times 10^{-5}$	0.01
Barium	23	$2.3 \times 10^{-6}$	$2.9 \times 10^{-5}$	$1.2 \times 10^{-4}$	$8.5 \times 10^{-4}$	1.0
Cadmium	2	$2.0 \times 10^{-7}$	$2.4 \times 10^{-6}$	$1.0 \times 10^{-5}$	$7.4 \times 10^{-5}$	0.01
Chromium	13219	0.001	0.017	0.073	0.51	0.05
Copper	58	$5.8 \times 10^{-6}$	$7.1 \times 10^{-5}$	$3.0 \times 10^{-4}$	0.002	1.0
Iron	150	$1.5 \times 10^{-5}$	$1.8 \times 10^{-4}$	$8.0 \times 10^{-4}$	0.006	0.3
Lead	16	$1.3 \times 10^{-6}$	$2.0 \times 10^{-5}$	$8.4 \times 10^{-5}$	$5.9 \times 10^{-4}$	0.05
Manganese	11	$1.1 \times 10^{-6}$	$1.3 \times 10^{-5}$	$5.7 \times 10^{-5}$	$4.0 \times 10^{-4}$	0.02
Zinc	24	$2.4 \times 10^{-6}$	$2.9 \times 10^{-5}$	$1.2 \times 10^{-4}$	$8.8 \times 10^{-4}$	5.0
Chlorides	26240	.002	.032	0.13	0.97	250
Cyanide	51	$4.9 \times 10^{-6}$	$6.3 \times 10^{-5}$	$2.7 \times 10^{-4}$	.002	0.01
Fluorides	245	$2.0 \times 10^{-5}$	$3.0 \times 10^{-4}$	.001	0.01	1.3
Nitrates	113,255	0.011	0.140	0.60	4.2	45
Sulfates	465,670	0.040	.57	2.4	17.3	250
Phenols (as PCP)	28023	0.004	0.043	0.186	1.305	0.001

TABLE XI

CALCULATED CONCENTRATIONS OF VARIOUS SUBSTANCES  
IN CLINCH RIVER AT AVERAGE FLOW OF 5000 CFS

SUBSTANCE	Usage (lbs) 1968	Calculated Concentration (mg/l)				USPHS Standard (mg/l)
		264-Day Year	22-Day Month	40-Hr. Week	8-Hr. Day	
Arsenic	2	$8.3 \times 10^{-7}$	$1.0 \times 10^{-5}$	$4.4 \times 10^{-5}$	$2.22 \times 10^{-4}$	0.01
Barium	23	$9.3 \times 10^{-6}$	$1.1 \times 10^{-4}$	$4.9 \times 10^{-4}$	0.003	1.0
Cadmium	2	$8.3 \times 10^{-7}$	$1.0 \times 10^{-5}$	$4.4 \times 10^{-5}$	$2.22 \times 10^{-4}$	0.01
Chromium	13219	0.006	0.067	0.295	1.474	0.05
Copper	58	$2.3 \times 10^{-5}$	$2.7 \times 10^{-4}$	.001	0.006	1.0
Iron	150	$6.8 \times 10^{-5}$	$8.1 \times 10^{-4}$	.004	0.018	0.3
Lead	16	$6.7 \times 10^{-6}$	$8.0 \times 10^{-5}$	$4.0 \times 10^{-4}$	0.002	0.05
Manganese	11	$4.5 \times 10^{-6}$	$5.4 \times 10^{-5}$	$2.0 \times 10^{-4}$	0.001	0.02
Zinc	24	$9.3 \times 10^{-6}$	$1.1 \times 10^{-4}$	$4.9 \times 10^{-4}$	0.003	5.0
Chlorides	26240	0.011	0.132	0.582	2.91	250
Cyanide	51	$2.3 \times 10^{-5}$	$2.7 \times 10^{-4}$	0.001	0.006	0.01
Fluorides	245	$1.1 \times 10^{-4}$	0.001	0.006	0.030	1.3
Nitrates	113,255	0.048	0.57	2.52	12.60	45
Sulfates	465,670	0.197	2.36	10.4	51.9	250
Phenols	28023	0.012	0.142	0.624	3.120	0.001

TABLE XII

COMPARISON OF CALCULATED VALUES OF CHEMICAL CONCENTRATION  
WITH ANALYTICAL RESULTS

	Annual Usage (lbs)	W.O.D. Calculated (mg/l)	W.O.D. Analysis (mg/l)	USPHS Standard
Cr <sup>+6</sup> *	13,219	.48	.13	0.05
Cl <sup>-</sup>	26,240	4.02	5.83	250
SO <sub>4</sub>	465,670	6.21	31.3	250
Phenol *	28,023	1.02	.0003	.001

\*7 days -- 24 hr. day